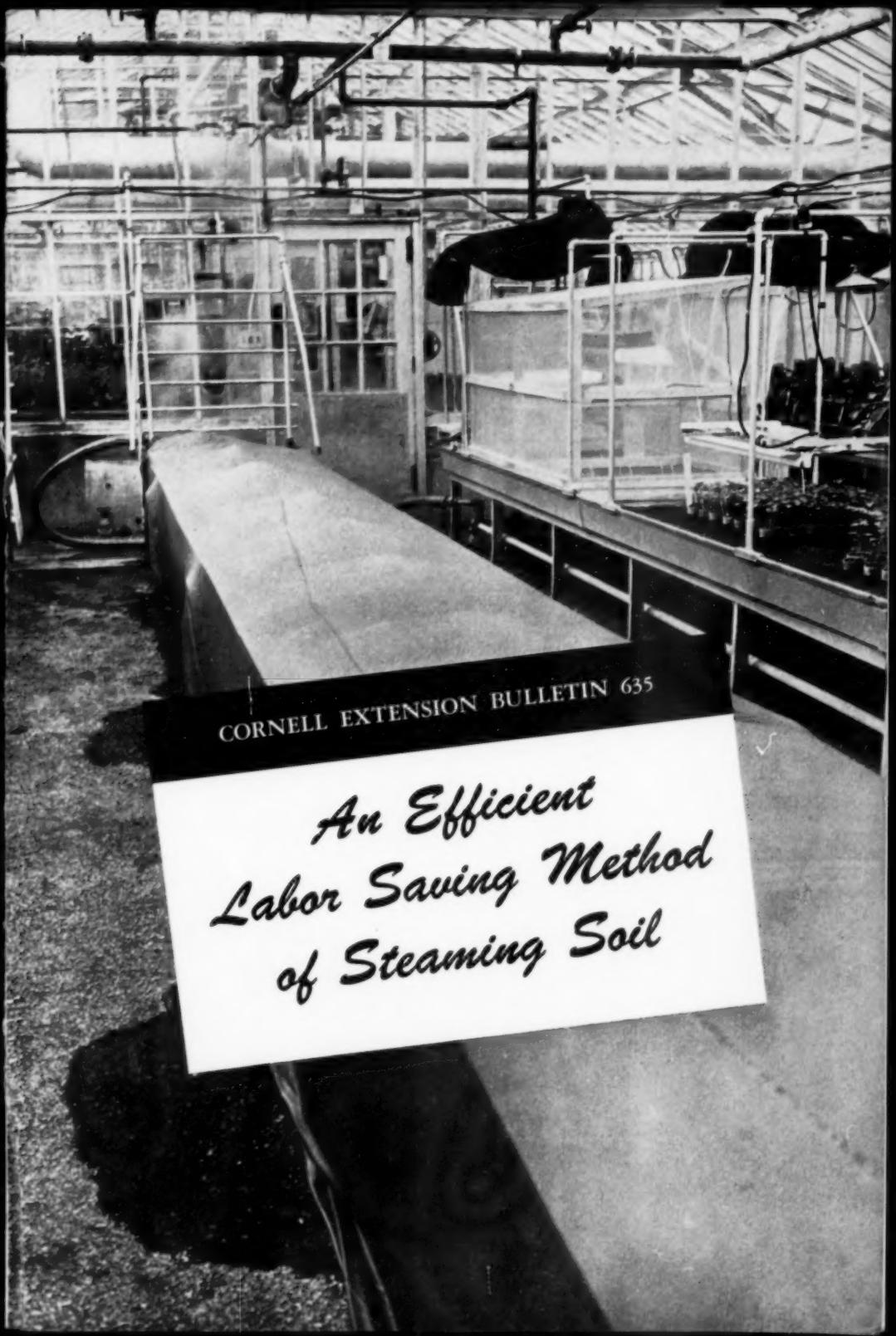

CORNELL EXTENSION BULLETIN 635

An Efficient Labor Saving Method of Steaming Soil

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COOPERATIVE EXTENSION SERVICE
NEW YORK
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An Efficient, Labor-Saving Method of Steaming Soil[1]

Why Sterilize Soil[2]

Briefly, the purposes of soil sterilization are: (1) to destroy harmful fungi, bacteria, insects, and other organisms; (2) to kill weed seeds and thus eliminate the labor of weeding; (3) to improve the physical condition of the soil; and (4) to save the labor of changing soil.

Methods of Sterilization

Well-known methods of soil sterilization include: hot-water drench; buried-tile and buried-perforated-pipe steaming; inverted-pan steaming; formaldehyde drench; and fumigation with chloropicrin, methyl bromide, and other materials. Each method has its advantages, but each has certain disadvantages.

The two methods of steaming bench or bed soil most frequently employed have been: (1) the *buried-tile* or *buried-perforated-pipe method* whereby the steam, conducted through tile or perforated pipes buried in the bench or bed soil, escapes into the soil and heats it to the required temperature; and (2) the *inverted-pan method* in which the steam is injected under a specially constructed inverted metal pan and is thus forced into the underlying soil. The *simplified method* described[3] herein embodies some features of both of these methods. The steam is conducted along the length of the bed or bench *on the surface* of the soil but is confined and forced to penetrate the soil by means of a steam-tight covering over the entire bench.

While the surface method of steaming described in the following pages does not remove all objections, it does eliminate most of the more serious drawbacks of the other methods. Little equipment is needed and most of it is readily available and inexpensive; far less labor is required to prepare

[1]This revision was prepared by A. W. Dimock, Professor of Plant Pathology, and the late Kenneth Post, Professor and Head of the Department of Floriculture and Ornamental Horticulture, Cornell University.

[2]The term *sterilize* is here used to indicate the killing of plant-disease-producing organisms. Many harmless bacteria and fungi are not killed by the treatments mentioned.

[3]This method was described by John R. Thomas, cut-flower grower of Whitford, Pennsylvania, at the 1942 Short Course for Florists at Cornell University.

the beds than is needed with the buried-tile or buried-pipe method; hot pipes do not have to be dug up and handled; steaming may be done in a house where plants are growing in adjacent benches; the soil is left in good condition and may be planted as soon as it cools; and, except for an occasional look at the boiler, the operator is free to do other work while the soil is steaming.

Information on other soil-treatment methods may be obtained from your County Agricultural Agent or your Experiment Station Pathologist.

Soil

Have the soil somewhat dry

Thoroughly water the soil about a week in advance of steaming, but allow it to become somewhat dry before steaming. Wet soil takes longer to steam and, because of condensation, the soil may be too wet to plant when steaming is completed. Soil uniformly somewhat dry at the start is usually about right for planting when steaming is finished.

Work up the soil

Work the soil well by forking over or power tilling to break up lumps and to permit rapid penetration of the steam. It is not necessary to pull the soil away from the side boards and to center of the beds; in fact, you should not do this. Leave the soil as it is after you work it.

Steam Conductors

Kinds

The surface method differs from older methods of steaming in that the steam conductor is not buried but is placed on the surface of the soil. Ordinary sheet-metal downspout, such as that used for draining water from the eaves, is a satisfactory conductor. Cut into sections from 4 to 10 feet long and lay these on the surface of the soil, with a gap of from ½ to 3 inches between sections. This permits rapid movement of steam to the ends of the bench, yet allows ready escape of steam at numerous points along its length. There is no advantage in perforating these short lengths of conductor.

Excellent results have been obtained also with large (4- to 5-inch diameter) porous canvas hose. Unroll the hose along the bed, tie off any surplus length, and tie the open end around the end of the steam hose. As the canvas hose fills with steam it raises the plastic cover, and the lateral distribution is rapid. The rolled-up hose is compact and easily stored.

Some growers have obtained good results by merely propping the cover up in the center of the bench with two-by-fours, balls of chicken wire, bent pieces of wire stuck into the soil like croquet wickets, small sacks of straw, or 4- or 5-inch flower pots placed on their sides in a row on the soil.

Introducing the steam

When you are to sterilize a short length of bed, you may introduce the steam at one end; for long beds or benches, it is best to introduce the steam at the center of the bed. If you introduce steam at the end, attach the end of the hose to a fitting that deflects some of the steam back toward the end of the bed. Otherwise, the steam rushing into the downspout may create a partial vacuum which draws the plastic cover down on the soil at the end of the bed, thus greatly slowing down the heating of that portion of the soil. If you introduce the steam at the center of the bench, attach a tee to the end of the hose to direct the steam toward either end of the bed or bench.

Covers

After you have arranged the conductor, lay the shovels, hoes, rakes, and other tools on the bench for steaming and put the cover in place. Use a cover that is nearly impervious to steam and strong enough to resist tearing. The most satisfactory materials available are different kinds of pure polythylene or vinyl plastic films or plastic-impregnated fabrics. Plastic covers of 4 mils thickness are available and widely used, but many growers prefer the more durable 8-mil covers or impregnated fabrics. All of the commonly used materials are lightweight, rot proof, and reasonably resistant to tearing and puncturing. Minor tears are easily repaired with pressure-sensitive plastic tape. Opaque plastic covers are reportedly more resistant to the somewhat injurious action of sunlight, but clear plastic has the advantage that thermometers placed in the soil can be read through the film during the steaming operation. Seamless covers 6 feet wide are available from most florist supply houses and are about the right width for the average greenhouse bench. With careful handling, most of the plastic or plastic-impregnated covers last almost indefinitely. They serve also as excellent covers for gas sterilization.

Working around pipes

Place a separate cover on each side of the bench and roll the adjoining edges together around a wire or rope stretched tightly from pipe to pipe (figure 1). Fasten the rolled edges to the wire with clothespins and tie the cover around the pipes with string.

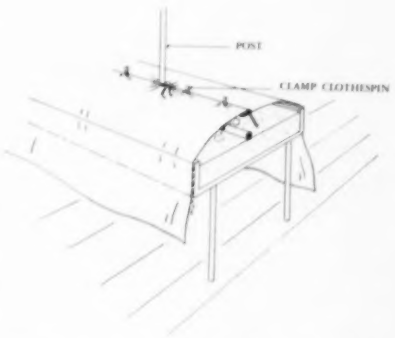


Figure 1. To cover benches in which there are support posts, bring two covers together and clip them around a rope or wire stretched between the posts.

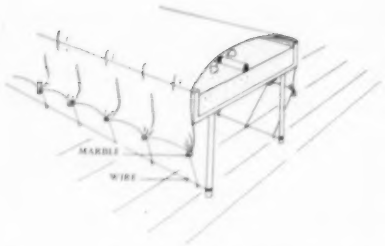


Figure 2. If the benches have irregular or rough side boards, secure the edges of the covers to wires stretched between the legs of the bench.

Fastening the covers

Condensation on the inside of lightweight pure plastic covers runs down and seals the cover to the sides of smooth wooden, steel, or concrete benches; no additional fastening is needed. An occasional pat where steam escapes closes the opening. On raised benches with rough sides, tie the covering at intervals to a wire stretched between the bench legs. Secure the tie-strings to the cover by gathering the fabric about small marbles and tying securely (figure 2). Clamps have been used successfully to hold covers of heavier, less pliable materials to bench sides. Fire hose, log chain, or some other flexible material can be laid on the cover at the outside of ground beds to prevent steam loss (figure 3).

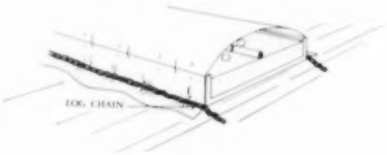
Steam to 160° F

Turn the steam on gradually so that the cover will not be blown off. High pressure is not necessary. The time required for steaming is determined by the temperature of the soil at the start, its water content, the available steam, steam loss, and other conditions. The only sure way to tell whether enough time has been given is to test the temperature with a thermometer. When the soil in the coldest spots reaches 180° F, turn the steam off, but leave the cover on for 30 minutes. Then remove the cover to permit the steam to escape. The soil becomes workable in a shorter time than if the cover is left on longer.

Although raised benches are more rapidly and effectively sterilized, steam will also penetrate ground beds to a depth of 8 to 12 inches if the soil has been properly loosened. A longer time will be needed to steam ground beds than raised benches.

Use any thermometer that is accurate and registers temperatures to about 220°F. Special soil thermometers are available, but dairy thermometers are equally good and are inex-

Figure 3. To hold the cover down against walks adjacent to ground beds, use heavy chains, old fire hoses, or some other somewhat pliable materials. These are better than 2 by 4's or pipes that will not conform to variations in the walk level.



pensive. Such thermometers may be read through clear plastic covers. Old automobile radiator thermometers, obtainable from used-parts dealers, have been used satisfactorily. Bury the thermometer bulb at the end of the flexible tube in the soil but leave the temperature indicator out in the open.

Soluble Salts

Steaming apparently releases some of the fertilizer salts and perhaps certain toxic materials into the soil solution. Sometimes these are injurious to the plants, especially if the crop preceding steaming was heavily fertilized near the end of the growing period. Work chopped straw, sugar cane pulp, or other organic material into the soil before steaming, or leach the soil before or after planting, to prevent injury. Leaching consists of watering until the water runs through the bench freely and, after it has drained, going over it again at least twice. Usually you can do this safely after planting, so that no time is lost. The old notion that a long period must elapse between steaming and planting is incorrect. You may plant any loose, well-aerated soil that has not been overly enriched with manure as soon as it cools. The production of an injurious amount of ammonia has been troublesome in some soils, but this can be prevented by working calcium sulfate (gypsum) into the soil at the rate of 2 pounds to 100 square feet of area before steaming.

Many Uses

The surface method is easily adapted to coldframe steaming as well as to the steaming of greenhouse bench soils. Potting soil mixed for use can be spread out on the potting bench or floor, covered, and the steam injected the same as for a small bench. Edges of the cover are best held down against the floor with "sand snakes" made by filling 8- or 10-foot lengths of 3-inch diameter canvas tubes with dry sand. The tubes are easily made by folding 12- or 13-inch-wide canvas strips lengthwise and sewing the edges together.

Flats of soil prepared for seeding should be stacked with a 1-inch piece of wood between them to allow steam to penetrate. Cover the stack with plastic sheeting and inject the steam. This is a more readily adaptable and less expensive method than the steam chamber often suggested.

Used pots that may carry disease-producing organisms may be laid on the floor, bench, or potting table, covered, and steamed to kill such organisms. Always sterilize old pots that may be carrying the calla or poinsettia root-rot organisms before using them a second time.

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